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Plasma Effect on the Formation of Alumina Dust

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Presolar oxide dust of Al2O3 has been identified in meteorites. Oxide grains are found to be less abundant compared to carbon rich grains present in meteorites. The alumina has many phases, alpha- (corundum), theta-, gamma-, delta-, kai-, lambda- and so on. The corundum is one of the most refractory phases predicted to condense first from a gas of solar composition [Grossman, 1972]. The gamma phase is considered as one of the carrier of 13 um absorption observed around AGB-star [Koike et al, 1995].
In previous paper, we reported production of nm-sized alumina grain from gas phase, and showed that the alumina particle produced was delta-Al2O3 [Kurumada et al, 2005]. IR spectrum for delta-Al2O3 also showed the peak around 13 um, as well as the gamma phase. The IR absorption due to AlO6 octahedral and AlO4 tetrahedral clearly appeared.
In present study, we will discuss about the effect of plasma on the formation of the alumina nanoparticle. Alumina was evaporated in the RF-plasma of He-O2 (7 Torr: 3 Torr) mixture gas, and alumina nanoparticle produced was collected from RF or Earth electrode. The structural analysis by electron diffraction indicated that both no-plasma and with-plasma alumina were same structure of delta phase. However, both IR spectra of alumina sample collected from each electrode indicated sharp feature at 7.2 um, C-H deformation or C-O stretching vibration modes. Therefore, this difference seen for IR spectrum is due to the surface condition of alumina nanoparticles. The alumina produced in the plasma field is considered to have active surface. The active surface easily reacts with the H2O or CO2 in air, when it is exposed into air.

Grossman L., 1972, Acta, 36, 597. Koike C. et al., 1995, ICARUS, 114, 203. Kurumada M., et al., 2005, Mon. Not. R. Astron. Soc., 359, 643.